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ABSTRACT

A study evaluated the ability of older adults to accurately perceive and retain Spanish in their short-term memory. Specifically, the study investigated differences in native language (English) auditory perception, short-term native language auditory memory capacity, monolingual age differences in auditory perception ability in an unknown language, and age differences in auditory perception ability among adults with some proficiency in Spanish. Ten different tests of perception, memory, and comprehension in both languages were administered to four groups of current or former missionaries of the Mormon Church. The younger participants were between the ages of 19-25, and the older participants were between the ages of 50-79. Participants were English monolinguals and native English-speakers with some Spanish proficiency. Results are reported and examined for each test and group. An analysis suggests that, in general, older adults have a somewhat greater difficulty in perceiving second-language speech. However, both older and younger adults showed similar auditory memory capacity. Every measure indicated greater variation among older adult scores. (MSE)

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Younger and Older Second Language Learners:
A Comparison of Auditory Memory and Perception

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**Younger and Older Second Language Learners:
A Comparison of Auditory Memory and Perception**

A great deal of research in second language (L2) acquisition has been devoted to understanding differences between child and adult acquisition. An area which has largely been neglected to date is the process of L2 acquisition for older learners (in their fifties, sixties, and seventies) (Brown, 1983). The goal of this study was to assess some of the capabilities of older adults, specifically, auditory memory and perception, which may influence their success in L2 acquisition, and to establish how these abilities may be similar to or different from those of younger adult learners.

Background

Though it may be less common for older adults to undertake the task of acquiring a new language, there are a number of reasons why some may choose or be required to do so.

Older immigrants--grandparents, aunts, and uncles in extended families--face the challenges of acquiring at least minimal competence in a second language as they adjust to life in a new country. Unless older immigrants are able to acquire some proficiency in the new language, they may find themselves unable to communicate with sons- or daughters-in-law from the new country, or with grandchildren who may grow up with little or no knowledge of the mother tongue (Spitzer, 1984). The plight of older immigrants and refugees has most often been overlooked in planning social services; however, there have been a few attempts to offer language training programs specifically designed with their needs and abilities in mind (Wienstein-Shr, 1989).

Improved health care in many countries has resulted in a growing population of older adults who can look forward to productive years beyond retirement age (Weinstock, 1978). Some retired persons have turned to the study of a foreign language as a means of remaining active and involved in meaningful learning activities (Brandle, 1986; Harwood & Naylor, 1975/76; Kalfus, 1977; Zdenek, 1983). An increasing number of Peace Corps volunteers are older Americans who work on development projects in various parts of the world, including Africa¹ (Ndungu, personal communication, May 1985; Roumani, 1978). In certain religious groups, retired persons may serve as missionaries in foreign countries. In short, there is a growing population of older language learners, and hence a need for understanding how the effects of aging may influence the process of L2 acquisition.

When a learner is confronted with the task of acquiring an unknown language, he or she must begin to recognize and decipher the sounds of the new language, segmenting the speech stream into meaningful units which form patterns of words, phrases, and larger discourse elements. The ability to accurately perceive and retain incoming information in short-term memory is crucial to this process. For an older learner this task may be especially challenging due to changes in physical and mental functioning which occur with age (Bayles & Kazniak, 1987; Geschwind, 1980; Kinsbourne, 1980; Obler & Albert, 1977, 1980). At the same time, as several researchers have observed (Brown, 1983; Harwood & Naylor, 1975/76; Schlepegrell, 1987), one of the

¹For example, in 1985 a group of 21 Peace Corps trainees, ranging in age from 50 to 78, received training in Naivasha, Kenya.

greatest barriers to successful language learning by older adults may be the lack of confidence they and others evidence in their ability to accomplish this task.

Even though physical and mental changes may occur with age, many individuals remain active and capable of further learning and growth. The few studies (Brown, 1983; Harwood & Naylor, 1975/76; Zdenek, 1983) which have focused on the language learning experiences of older adults have generally concluded that they are capable of much greater success than may have initially been assumed, especially when programs are tailored to meet their needs.

Although there has been little research examining the L2 acquisition of older adults, a considerable amount of information about their general cognitive and linguistic abilities is available. A review of major findings in areas related to language abilities may offer insight into the strengths and weaknesses they bring to the challenging task of acquiring an additional language.

A general finding in studies involving older adults is the tremendous variability in performance which is often apparent, both for a single individual and among different individuals (Albert, 1980; Schaie, 1980). This variation appears to be much greater in most areas than for younger adults. In addition, Bergman (1980) observes that variability among individuals increases with the difficulty of the task. Albert suggests various factors which may influence this variability:

It would seem that performance by older people on specific tests of language is dependent on a complex combination of factors. One has to do with changes in language itself. Others have to do with changes in other cognitive skills, especially memory and perception. Also, changes in emotional state such as loneliness, depression, and especially fear of making mistakes, play a role. Physical state contributes, as does social expectation. (p. 146)

This phenomenon makes it difficult to generalize about the abilities of older people; however, certain trends have been observed.

In terms of memory abilities, there is little evidence that memory traces degenerate more rapidly in sensory or precategorical acoustic storage in older adults than in younger adults (Bergman, 1980; Storandt, 1980; Working Group on Speech Understanding and Aging, 1988). In addition, working memory capacity, often measured by digit recall tasks, appears to decline only slightly with age (Botwinick & Storandt, 1974). However, substantial age differences have been revealed in dynamic measures of capacity, in which an individual must retain items in memory while performing some operation on them (Working Group on Speech Understanding and Aging, 1988). For example, pronounced age differences have appeared on tests of backward digit span, in which a string of digits must be repeated in reverse order (Bromley, 1958).

Remote memory, or very long-term memory for events which happened long ago, appears to remain intact. Difficulties that older adults encounter in remembering appear to involve changes in processing and retrieval mechanisms. It seems that elderly adults do not spontaneously process new information as deeply at the time of acquisition, which may explain their greater

difficulty in information retrieval (Craik & Simon, 1980). Nevertheless, Craik and Simon found they were able to virtually eliminate the age deficit in a semantic encoding task by guiding both input (through appropriate orienting) and retrieval (using recognition rather than recall) tasks in an optimal fashion. As a result they concluded that "the age deficit is a production deficiency--it is a failure to carry out operations which, nonetheless, the subjects are capable of carrying out" (p. 100).

An important factor in information processing is the operation of attentional systems, which enable an individual to deal with very large amounts of simultaneous stimuli and make appropriate responses. Aging appears to effect a change in attentional systems (Geschwind, 1980), and this may be part of the reason older adults fail to process incoming information as deeply as younger adults. Kausler and Kleim (1978) discovered that older adults have difficulty ignoring irrelevant stimuli, resulting in a reduction in the amount of processing capability available. Cohen and Faulkner (1983) found that older adults were more disadvantaged when using strategies that made greater processing demands or imposed a heavy memory load. However, age differences were significantly decreased when the older adults made use of strategies which reduced the amount of processing necessary to accomplish the task.

It also appears that older people may process information more slowly than younger people, and hence require longer times to reach equivalent encodings (Craik & Simon, 1980; Waugh & Barr, 1980). In a time-restricted task such as perception of running speech, a delay in encoding may result in an irretrievable loss

of information through trace decay or interference from succeeding input (Wingfield, 1980). It is evident then, that the abilities of older adults in processing the target language speech stream are taxed to an even greater extent than those of younger adults.

Speech discrimination and comprehension also decrease with aging (Albert, 1980; Rupp, 1980; Working Group on Speech Understanding and Aging, 1988). This loss in ability appears to be due to changes in the peripheral auditory systems as well as in the central auditory cortex (Bergman, 1980). Rupp (1980) reports that the incidence of handicapping hearing loss among aging adults has been estimated by various surveys to be from ten to ninety percent. Hearing loss in old age, known as presbycusis, initially appears to affect older men to a greater extent than older women (Robinson & Sutton, 1979). However, as age increases, the difference in hearing acuity between men and women becomes less noticeable until they are very similar by the eighth decade of life (Harford & Dodds, 1982). In presbycusis, perception of higher frequencies is usually most affected, though weakening of abilities also appears to occur in the processing and transmitting of the speech signal. Stevenson (1975) found that hearing loss may result in difficulty in discriminating phonemes.

It is apparent from research on the cognitive and linguistic abilities of older learners that the task of processing the speech stream of a new language is considerably more challenging for older than younger adults. Decreased hearing abilities may make it more difficult to form accurate auditory images of L2

speech sounds. Changes in attentional systems and in depth of processing may cause difficulties in integrating new information about the target language with existing interlanguage structures, limiting progress in acquisition. Most research on processing and memory in the elderly has examined differences in semantic or episodic memory. The acquisition of a second language represents a very different task from remembering specific words or specific events, as much interlanguage development appears to evolve as a result of information obtained at levels of processing not normally accessible to the conscious attention of the learner. Very little is known about the effects of aging on this process of acquisition. As stated above, this study represents an effort to evaluate the auditory memory and perception abilities which older adult learners bring to the task of L2 acquisition.

Method

The purpose of the present study was to evaluate the ability of younger and older adults to accurately perceive and retain in short-term memory foreign language speech, in this case, Spanish.

As discussed above, studies have shown short-term auditory memory capacity does not appear to be much affected by aging. On the other hand, auditory perception may be diminished by changes in peripheral auditory systems and in the central auditory cortex. Previous studies of older adults have assessed working memory and perception in terms of a fully-developed linguistic system, the native language; it is not known how capacities may differ when older adults are confronted with input from an unknown or partially-acquired language. Because their grasp of target language linguistic subsystems may be incomplete or non-

existent, it may be more difficult for them to effectively use the redundancy inherent in the speech signal to compensate for diminished abilities.

The specific research questions addressed by the present study were as follows:

1. Do younger and older adults differ in auditory perception abilities in their native language (English)?
2. Do younger and older adults differ in short-term auditory memory capacity in their native language?
3. Do younger and older adult monolinguals differ in auditory perception abilities in an unknown language (Spanish)?
4. Do older and younger adults who have some proficiency in a second language (Spanish) differ in auditory perception abilities (taking into account the differences in their level of proficiency)?

In order to address the first two research questions and establish a baseline of subjects' abilities in their native language, a puretone air-conduction hearing assessment and various perceptual and memory tasks in English were administered. Comparable aspects of subjects' abilities in Spanish were assessed in order to address the remaining research questions.

The hearing assessment was used as a screening procedure to identify subjects who should not be included in the study because of hearing disability. As the experimental tasks were presented binaurally, subjects were screened on the basis of the acuity of their better ear. They were disqualified if the puretone threshold average (the average of threshold levels at 500, 1000,

and 2000 Hz) for their better ear was greater than 25 dB, generally considered the threshold of impaired hearing function (Yantis, 1985).

Following are descriptions of the test instruments used in the study:

1. Speech Perception in Noise (SPIN): Two forms of the SPIN test, modified by Bilger et al. (1984) from those developed originally by Kalikow et al. (1977), were combined in this study. Test items consisted of brief sentences in English which ended in monosyllabic, high frequency words, presented against a babble of twelve voices, at a signal-to-babble ratio of 0 dB.²

The test contained one hundred items; in half of the items the final word was highly predictable from the sentence context ("All the flowers were in bloom"), while in the other half the word was not predictable from context ("I had a problem with the bloom"). The items were interleaved in a pseudo-random fashion, with not more than three high-context or three low-context items occurring in sequence.

Subjects were instructed to write down the last word in each item. Words were scored as correct even if they were misspelled, but no morphological changes were accepted. The fifty high-context (SPIN-HC) and fifty low-context (SPIN-LC) items were scored separately, as Bilger et al. (1984) had found that the two

²This test was chosen because it appeared to represent a more sensitive indication of actual speech comprehension abilities in circumstances where some degree of noise is present in the background. Many studies have shown that older listeners often have a greater difficulty comprehending speech degraded by background noise than results of puretone audiometric tests or tests of speech recognition in quiet might indicate (Davignon & Leshowitz, 1986; Dubno, Dirks, & Morgan, 1984; Duquesnoy, 1983).

contextual environments resulted in truly different types of test items. The low-context item score provided a measure of a subjects' auditory word discrimination ability in noise, while the high-context item score assessed his or her use of contextual information.

2. Random Digits Forward (DIGFOR): This test was designed as a measure of auditory memory span, and consisted of twenty sets of random digits which increased in length from three to twelve digits. The test was scored in two ways: 1) the total number of sequences which were repeated without error, and 2) the total number of digits repeated in correct sequence (even though incorrect digits might intervene).

3. Random Digits Reversed (DIGREV)³: This task consisted of sixteen sets of random digits which increased in length (from four to eight digits). Subjects repeated the numbers in each sequence in reverse order. The test was scored in two ways: 1) according to the traditional method given for the Woodcock-Johnson Psycho-Educational Battery, where a subject received one point for each set of digits repeated correctly; and 2) in a manner similar to the scoring of the random digits forward task described above, where credit was given for each digit which was repeated in the correct sequence (the reverse of the original sequence in this case).

4. English Memory for Sentences (ENGMEM)⁴: This test consisted of twenty brief sentences of increasing length (from two to

³Subtest 10 of the Memory Cluster of the Woodcock-Johnson Psycho-Educational Battery (1977) was used for this task.

⁴Subtest 3 of the Woodcock-Johnson Psycho-Educational Battery (1977).

twenty words). Subjects repeated each sentence. The test was scored in two ways: 1) a subject received one point for each sentence repeated without error, according to the traditional method; and 2) credit was given for each correct word.

5. Spanish Memory for Sentences (SPANMEM): In this task subjects repeated meaningful words, phrases, and sentences of increasing length in Spanish. The items increased in length from two syllable words, to phrases of four syllables, to sentences of approximately eight syllables, twelve syllables, sixteen syllables, and twenty syllables in length, for a total of thirty items. All but one of the words in the example and test items were high frequency words, occurring within the first 3000 words of the Rodriguez-Bou (1952) count. With one exception, all verbs were in the present tense.

Subjects' repetitions of the test items were transcribed in IPA format by the author. As this exercise was intended more as an assessment of subject's perception at the phonemic level than of his or her ability to approximate native Spanish pronunciation, the acceptability parameters used in scoring were quite broad. In general, a phoneme was judged correct if it might be assumed to be intelligible to a native Spanish-speaker, even though its phonetic realization may not have approached native-like pronunciation. Hence, many English-like pronunciations of vowels and consonants were considered acceptable. Subjects received credit for the number of phonemes produced correctly in response to the items (SPANMEM-ACC), and for the total number of phonemes (regardless of correctness) produced (SPANMEM-AMT). The latter measurement was intended to

provide an idea of a subject's willingness to undertake the task and/or to risk making errors.

6. Accent Detection (ACCDET)

In this test subjects heard a word in Spanish and were required to judge whether or not it had been pronounced in a native-like fashion. There were thirty-five high frequency words, occurring within the first 3000 words of the Rodriguez-Bou count. Each word consisted of two syllables, the first syllable beginning with a consonant or vowel and containing the stressed vowel /a/, /o/, or /i/, followed by p, t, k, b, d, g, flap r, or trilled r, and an unstressed /a/ or /o/. Each word was pronounced twice, once with a native Spanish accent and once with a non-native (i.e., Americanized) accent; the seventy items were sequenced randomly. Subjects indicated on an answer sheet whether they believed a word had been pronounced with a native-like or an American accent.

7. Non-contextualized Discrimination (NC-DISC)

This task was designed to assess a subject's ability to distinguish spoken minimal pairs (words which vary in only one phoneme) in Spanish. The minimal pairs met the specifications of the two-syllable words described in the Spanish Memory for Sentences task in terms of their phonemic makeup and word frequency. A total of ten contrasts were included: /p/-/b/, /t/-/d/, /k/-/g/, /p/-/t/, /t/-/k/, /b/-/d/, /d/-/g/, /t/-flap r, /d/-flap r, and flap r-trilled r. There were two minimal pairs for each contrast, one pair with the contrast occurring in the first syllable, and the other with the contrast occurring in the second syllable. Each pair was presented four times in the test,

twice with the key words being the same (for each member of the pair), and twice with the key words being different (with the order of the key words reversed), for a total of eighty test items, which were sequenced randomly.

Test items consisted of a word and then the sentence frame "Dije la palabra _____" ("I said the word _____"), in which the last word was either the same or the pair of the word heard before the sentence. Subjects were instructed to identify whether the word before the sentence and the last word in the sentence were the same or different.

8. Contextualized Discrimination (C-DISC)

This task employed the same minimal pairs described above, however, instead of occurring in a sentence frame which remained static across items, each word occurred in a meaningful sentence. Subjects heard a word and then a sentence containing either that word or the other member of the pair. Each sentence was heard twice in the course of the task, once with the same word occurring before the sentence, and once with the other member of the pair occurring before the sentence, for a total of eighty test items. Subjects recorded their judgments after each item on a machine-scoreable answer sheet following the same procedure as described above.

As mentioned previously, this task and the following two tasks were only administered to bilingual subjects.

9. Listening Comprehension (LISTCOMP)

The listening subtest of one of the forms (MA) of the Spanish version of the Modern Language Association (MLA) Cooperative Foreign Language Tests (1964) was used in this study

to provide a measure of subjects' general ability to comprehend spoken Spanish.

10. Vocabulary Recognition (VOCAB)

The high frequency words used in the Spanish memory for sentences, accent detection, and noncontextualized and contextualized auditory discrimination tasks were listed alphabetically and subjects were asked to indicate whether or not they knew each word. This task was intended to provide insight into how well subjects might have comprehended the meaning of the sentences in the memory for sentences and contextualized auditory discrimination tasks.

Care was taken to control for an ordering effect in the administration of the experimental tasks. All speech materials were presented to the subjects at a normal conversational level, 65 dB SPL (Kryter, 1985).

Following is a description of the subjects who were involved in this research:

Subjects

All of the subjects in this study were persons who were serving or who had served as missionaries for the Church of Jesus Christ of Latter-day Saints (also known as the LDS or Mormon Church).

Four groups of subjects were involved: 1) young missionaries assigned to English-speaking missions (hereafter referred to as younger monolinguals), 2) older missionaries assigned to English-speaking missions (older monolinguals), 3) young returned missionaries who had served Spanish-speaking missions (younger bilinguals), and 4) older returned missionaries

who had served Spanish-speaking missions (older bilinguals). It should be noted that the term "bilingual" is used here to identify individuals whose competence in Spanish may range from minimal to advanced.

The means of the demographic characteristics of the subjects in each of the four groups are displayed in Table 1. An effort was made to include equal numbers of males and females in each group.

TABLE 1
Means of Subject Demographic Characteristics

Group	N	Age Mean	Age Range	Spanish yrs. ¹	Other yrs. ²	Educ. ³ yrs.
Yng Mon	28	20.6	19-23	0.1	0.1	13.4
Yng Bil	28	22.8	21-25	1.3	0.3	14.3
Old Mon	30	62.8	50-79	0.0	0.3	13.2
Old Bil	26	65.2	54-71	0.7	0.7	15.6

¹Years of formal instruction in Spanish

²Years of formal instruction in other languages

³Total years of formal education

Table 2 summarizes the means of the information on foreign residence obtained for the two groups of bilinguals. As can be seen, the older bilinguals generally spent slightly less time in the field (mean = 17.0 months) than the younger bilinguals.

TABLE 2

Means of Foreign Experience of Bilinguals

Group	N	Res. Mos. ¹	Ret. Mos. ²	Span. Hrs. ³	NS Comp, % Mos. ⁴
Yng Bil	28	17.9	13.0	13.1	56.4%
Old Bil	26	17.0	12.6	5.4	N/A

¹Months of residence in Spanish-speaking country

²Months elapsed since returning from Spanish-speaking country

³Average number of hours per day spent speaking Spanish

⁴Months spent with native Spanish-speaking companion

LDS missionaries always work in pairs, and the number of months that each younger bilingual subject was assigned to work with a native Spanish-speaking companion is shown in Table 2. The older bilinguals did not have this opportunity as they always remained with their spouses.

A striking difference between the two groups was in the number of hours they estimated they spoke Spanish daily while in the field. Overall, the younger missionaries reported averaging 13.1 hours per day, while the older group averaged 5.4 hours. The difference in use of Spanish between the younger and older bilinguals is likely due at least in part to the differences in their responsibilities and assignments in the mission field. The older bilinguals may also have spoken Spanish less frequently because of a lack of confidence in their ability (Brown, 1983).

Results and Discussion

Reliability coefficients for the tests employed in the study were obtained through Kuder-Richardson Formula 21, except for the Spanish memory for sentences task for which an inter-rater reliability estimate was computed.

For the Speech Perception in Noise (SPIN) test, the reliability coefficient for the high-context items (SPIN-HC) was .90 and for the low-context items (SPIN-LC) .78. Calculations yielded .92 for the random digits forward task (DIGFOR), .94 for the random digits reversed task (DIGREV), and .92 for the English memory for sentences (ENGMEM).

As explained previously, the English memory for sentences test and the random digits reversed test were subtests of Part I of the Woodcock-Johnson Psycho-Educational Battery. The range of coefficients published for the Memory for Sentences subtest was .72-.90 (median = .80); for Numbers Reversed the range was .70-.89 (median = .82) (McGrew, 1986).

Inter-rater reliability for the Spanish memory for sentences task (SPANMEM) was obtained by comparing scores based on the phonemic transcription of the author with those based on the transcription of another researcher trained in the IPA system. Recordings of eleven subjects (representing approximately ten percent of the subjects) were chosen pseudo-randomly so that a female and male from each of the age (older and younger adult) and language experience (monolingual vs. bilingual) groups was included. The Pearson product moment correlation between the scores based on the transcriptions of the two researchers was .99. This unusually high correlation was most likely a result of the rather broad acceptability parameters used in scoring as discussed above.

Reliability coefficients for the Spanish perception tasks were as follows: .88 for the accent detection task (ACCDT); .84 for the non-contextualized discrimination task (NC-DISC); and .89

for the contextualized discrimination task (C-DISC) (bilingual subjects only).

Calculations revealed a coefficient of .96 for the Spanish listening comprehension test (LISTCOMP). As explained earlier, this test is a subtest of the Spanish version of the Modern Language Cooperative Foreign Language Tests (form MA). The published reliability estimate for this subtest is .90.

Hearing Assessment

As described in the previous chapter, a puretone air-conduction hearing assessment was used to screen potential subjects. Individuals whose puretone threshold average (PTA or the average of threshold levels at 500, 1000, and 2000 Hz) for their better ear was greater than 25 dB were not included in the study.

The range of frequencies most crucial in understanding speech extends from approximately 400 to 3000 Hz (Davis, 1978). This range is represented in this study by a puretone threshold average. Information at frequencies above this range contributes additionally to distinguishing stops and fricatives (Borden & Harris, 1980). Presbycusis, or hearing impairment which occurs with aging, is most evident at higher frequencies; therefore, thresholds at 4000 and 8000 Hz will also be reported for comparison of older and younger subjects. Thresholds are reported for the better ear only as all of the tasks were presented binaurally.

Table 3 summarizes the mean PTA's and thresholds at 4000 and 8000 Hz (expressed in dB HL⁵ ANSI 1969) of older and younger monolinguals and bilinguals.

TABLE 3

Hearing Thresholds (PTA, 4000, 8000 Hz)							
	PTA		4000 Hz		8000 Hz		
	M	SD	M	SD	M	SD	
Yng Mon	4.35	3.91	-0.89	6.24	9.82	6.59	
Old Mon	9.33	5.50	29.83	17.44	45.00	18.71	
Yng Bil	2.44	4.02	-0.54	5.33	13.21	13.49	
Old Bil	10.83	6.52	28.46	17.31	51.92	22.68	

Although there was a difference between puretone threshold averages for older and younger subjects for both monolinguals and bilinguals, it must be remembered that PTAs for all subjects were within the limits of normal hearing. In contrast, mean hearing thresholds for older and younger monolingual and bilingual subjects at 4000 and 8000 Hz clearly show evidence of presbycusis among older subjects in both groups. Although information present at lower frequencies in the speech signal is usually adequate under quiet conditions for accurate speech perception, their increasing lack of sensitivity at higher frequencies may make it more difficult for the older subjects to correctly identify some consonants, especially under more challenging listening conditions such as imposed by the SPIN task where items are presented against a babble of voices.

⁵Hearing level (HL) is "the level [in decibels] of a sound relative to 0 dB HL, which is equal to average hearing threshold for young, normally hearing adults" (Katz, 1985, p. 1073). It is the dB reference on audiometers.

English Tasks

English auditory perception was evaluated through the SPIN test. As explained above, test items differed in whether or not they could be predicted from sentence context; high-context (SPIN-HC) and low-context (SPIN-LC) items were scored separately. Table 4 shows means and standard deviations for younger and older monolingual and bilingual subjects on these two measures.

TABLE 4

Speech Perception in Noise (SPIN)
Descriptive Statistics

	High-Context (50 items)			Low-Context (50 items)		
	M	SD	%	M	SD	%
Yng Mon	47.07	1.84	94.1	26.29	4.06	52.6
Old Mon	40.93	6.59	81.9	17.25	7.28	34.5
Yng Bil	48.64	1.42	97.3	26.29	4.23	52.6
Old Bil	42.31	8.11	84.6	17.85	6.79	35.7

As expected, all subjects performed better on high-context than low context items, as on high-context items they could use semantic clues from the sentence context to aid in narrowing the choices for final word identification under these difficult acoustic conditions. Younger subjects performed better on both types of items than older subjects, while the differences between monolingual and bilingual subjects appear to be quite small.

As outlined in the previous chapter, the memory tasks which were administered in English consisted of random digits forward (DIGFOR), random digits reversed (DIGREV), and English memory for sentences (ENGMEM). Descriptive statistics for older and younger

monolinguals and bilinguals on these tasks (based on the digit or word scoring method discussed earlier) are displayed in Table 5.

TABLE 5

English Working Memory Tasks
(Digit/Word Scoring Method)
Descriptive Statistics

DIGFOR (115 digits)			DIGREV (90 digits)			ENGMEM (147 words)		
M	SD	%	M	SD	%	M	SD	%

Monolinguals

Yng	45.39	14.33	39.5	32.68	15.08	36.3	111.37	16.74	75.8
Old	42.33	15.27	36.8	27.87	15.82	31.0	111.41	15.35	75.8

Bilinguals

Yng	59.43	16.96	51.7	43.04	16.56	47.8	125.61	15.93	85.4
Old	50.46	18.22	43.9	35.46	17.91	39.4	116.04	14.64	78.9

In order to compare the performance of older and younger monolingual and bilingual subjects on the English perception and memory tasks a two-way multivariate analysis of variance (MANOVA) was performed, using age and L2 experience (monolingual vs. bilingual) as independent variables. No significant interaction of age and L2 experience was discovered; however, both age and L2 experience revealed significant differences ($p < .001$ and $p = .003$ respectively). Table 6 displays the results of univariate F tests for age differences.

TABLE 6
English Tasks
Older vs. Younger Adults

Source	df	SS	MS	F	P
SPIN-HC	1	586.74	586.74	21.15	.001
Error	104	2885.15	27.74		
SPIN-LC	1	1185.35	1185.35	35.52	.001
Error	104	3470.51	33.37		
DIGFOR	1	60.17	60.17	0.22	NS
Error	104	27909.25	268.36		
DIGREV	1	394.74	394.74	1.47	NS
Error	104	27952.02	268.77		
ENGMEM	1	0.02	0.02	0.000	NS
Error	104	25622.46	246.37		

As mentioned earlier, the SPIN test requires perception under degraded conditions in which information at higher frequencies is more critical for consonant identification. Hence, it seems reasonable to conclude that the poorer performance of the older adults on these measures is due in large measure to inferior hearing acuity at higher frequencies.

Table 7 displays the results of univariate F tests assessing the significance of difference in L2 experience.

TABLE 7

English Tasks
Monolinguals vs. Bilinguals

Source	df	SS	MS	F	P
SPIN-HC	1	23.57	23.57	0.85	NS
Error	104	2885.15	27.74		
SPIN-LC	1	0.53	0.53	0.02	NS
Error	104	3470.51	33.37		
DIGFOR	1	2891.04	2891.04	10.77	.001
Error	104	27909.25	268.36		
DIGREV	1	1435.94	1435.94	5.34	.023
Error	104	27952.02	268.77		
ENGMEM	1	2786.01	2786.01	11.31	.001
Error	104	25622.46	246.37		

As will have been noted in Table 7 above, the mean performance of the bilingual subjects was consistently higher on all of the English working memory measures. As explained earlier, the DIGREV and ENGMEM tasks form the Memory cluster on the Woodcock-Johnson Psycho-Educational Battery. Using the norming information provided for this cluster, each subject was assigned a percentile rank based on his or her age, and these ranks were averaged across groups. The mean percentile ranks and standard scores are displayed in Table 8.

TABLE 8

Memory Cluster (DIGREV + ENGMEM)
Percentile Ranks and Standard Scores

	Percentile Rank		Standard Score ¹	
	M	SD	M	SD
Yng Mon	45.75	22.37	98.61	10.26
Old Mon	52.20	22.97	101.53	10.87
Yng Bil	64.00	22.84	106.82	11.68
Old Bil	65.19	21.25	106.65	9.35

¹mean = 100; standard deviation = 10

T-tests were also carried out to determine if the groups were significantly different from the sample on which the norms were based. While the monolingual subjects were not significantly different from their age norm in memory abilities, both the younger and older bilinguals were significantly above average ($p < .01$).

As this study was cross-sectional rather than longitudinal, the memory capacity of the bilingual subjects before acquiring Spanish is not known. Hence, it is not possible to say whether these subjects by nature had a greater memory capacity or whether the experience of acquiring a second language had influenced their capacity in some way.

In summary, the results of English tasks helped to establish a baseline of the subjects' auditory memory and perceptual abilities in their native language. Although norming information was not available for the SPIN measures, subject performance appeared to reflect general trends reported in the literature: all subjects performed better on the high-context items, and the

younger subjects performed better than the older subjects on both types of items. There was no significant difference in the performance of monolingual and bilingual subjects on the SPIN measures.

In contrast, although the performance of older and younger subjects did not differ significantly on the English measures of auditory memory (DIGFOR, DIGREV, and ENGMEM), there was a significant difference in the performance of monolinguals and bilinguals. Comparison with previously established norms showed the performance of monolinguals to be average, and that of bilinguals to be above average. This result was unexpected, and appears to have not been reported previously in the literature.

Spanish Tasks

Subjects were also assessed in terms of their working memory capacity and perception in Spanish. The monolinguals, of course, had no knowledge of Spanish, while the bilinguals had acquired varying levels of proficiency. Success in performing the Spanish memory task (SPANMEM) depended on perceptual abilities as well as working memory capacity, especially for the monolinguals, who were unable to use meaning to aid retention of the longer phrases and sentences. In addition, production skills were involved in repetition. Hence, subject performance on this task represents more than just memory capacity; the intent was to examine the effect of memory capacity limitations on performance in this combined perception/production task. Performance was evaluated in terms of the accuracy of the phonemes produced (SPANMEM-ACC) and the total number of phonemes produced regardless of accuracy (SPANMEM-AMT), which was assumed to reflect willingness to risk

making errors in attempting this challenging task. Table 9 displays descriptive statistics for both scores.

TABLE 9
Spanish Working Memory Task (SPANMEM)
Descriptive Statistics

	Accuracy (473 phonemes)			Amount (473 phonemes)		
	M	SD	%	M	SD	%
<u>Monolinguals</u>						
Young	194.00	27.06	41.0	338.00	57.62	71.5
Older	176.73	28.16	37.4	320.33	65.03	67.7
<u>Bilinguals</u>						
Young	423.86	40.79	89.6	456.96	35.62	96.6
Older	265.54	57.81	56.1	347.27	59.70	73.4

An examination of Table 9 reveals that the differences in the performance of younger and older monolinguals were relatively small on both measures. However, the young bilinguals produced more and performed with much greater accuracy than the older bilinguals.

All subjects were also asked to distinguish between native-like and non-native (American) pronunciation of individual words (accent detection or ACCDET) and between minimal pairs in Spanish (non-contextualized discrimination or NC-DISC). In addition, bilingual subjects were asked to discriminate between minimal pair words, one of which was embedded in a meaningful sentence (contextualized discrimination or C-DISC). Performance on these tasks is summarized in Table 10.

TABLE 10
Spanish Perception Tasks
Descriptive Statistics

	ACCDDET (70 items)			NC-DISC (80 items)			C-DISC (80 items)		
	M	SD	%	M	SD	%	M	SD	%
<u>Monolinguals</u>									
Yng	63.96	3.29	91.4	62.14	4.67	77.7			N/A
Old	55.10	9.92	78.7	56.57	4.88	70.7			N/A
<u>Bilinguals</u>									
Yng	65.36	4.12	93.4	75.82	3.21	94.8	76.64	1.91	95.8
Old	58.46	6.91	83.5	64.31	6.25	80.4	63.28	7.17	79.1

The younger adults, both monolingual and bilingual, received higher scores on all of these measures. At the same time, it is interesting to note that there was almost no difference in means between NC-DISC and C-DISC for both older and younger bilinguals, who took both tests. This would seem to indicate that the addition of sentence context in this type of auditory discrimination task had little influence on the performance of either age group. However, further analysis, discussed below, showed that this was not the case.

A two-way MANOVA was conducted in order to compare the performance of younger and older monolinguals and bilinguals on the Spanish perception tasks which both had received. A significant interaction between age and L2 experience was discovered. (Wilks' lambda was significant at $p = .005$). The univariate F tests for this interaction are displayed in Table 11 below:

TABLE 11

Spanish Perception Tasks
Interaction: Age and L2 Experience

Source	df	SS	MS	F	P
SPANMEM-ACC	1	138913.51	138913.51	87.62	.000
Error	108	171229.76	1585.46		
SPANMEM-AMT	1	59132.95	59132.95	19.03	.000
Error	108	335656.75	3107.93		
ACCDDET	1	27.06	27.06	0.61	NS
Error	108	4794.55	44.39		
NC-DISC	1	246.15	246.15	10.49	.002
Error	108	2534.44	23.47		

The interaction was significant for SPANMEM-ACC, SPANMEM-AMT, and NC-DISC. An examination of the means in Tables 9 and 10 reveals that the difference in performance between younger and older bilinguals was much greater than between younger and older monolinguals on these measures. For SPANMEM-ACC, the difference in the average number of phonemes correctly produced by younger and older monolinguals was 17.27, while the difference in the average performance of the younger and older bilinguals was 158.32. For SPANMEM-AMT, the difference in the average total number of phonemes produced by younger and older monolinguals was 17.67, while between younger and older bilinguals the difference was 109.69. Finally, the difference in performance on NC-DISC was 5.57 for younger and older monolinguals and 11.51 for younger and older bilinguals.

A significant effect for age was also discovered. Univariate F tests, displayed in Table 12, help to identify where differences occur.

TABLE 12

Spanish Perception Tasks
Younger vs. Older Adults

Source	df	SS	MS	F	P
SPANMEM-ACC	1	4317.86	4317.86	2.72	NS
Error	108	171229.76	1585.46		
SPANMEM-AMT	1	4520.23	4520.23	1.45	NS
Error	108	335656.75	3107.93		
ACCDET	1	1137.99	1137.99	25.63	.000
Error	108	4794.55	44.39		
NC-DISC	1	450.33	450.33	19.19	.000
Error	108	2534.44	23.47		

Due to the interaction of effects for SPANMEM-ACC, SPANMEM-AMT and NC-DISC, it is not possible to interpret the results for these measures. However, as the interaction was not significant for ACCDET, it may be assumed that there was a significant difference between older and younger subjects in both L2 experience groups on this measure. It seems that differences between older and younger adults in auditory abilities which were apparent on the English auditory perception task, may have also influenced performance on this task, which involved auditory perception skills primarily.

As would be expected, the effect of L2 experience was also significant. The results of univariate F tests are displayed in Table 13.

TABLE 13

Spanish Perception Tasks
Monolinguals vs. Bilinguals

Source	df	SS	MS	F	P
SPANMEM-ACC	1	739680.29	739680.29	466.54	.000
- Error	108	171229.76	1585.46		
SPANMEM-AMT	1	198135.02	198135.02	63.75	.000
Error	108	335656.75	3107.93		
ACCDDET	1	27.16	27.16	0.61	NS
Error	108	4794.55	44.39		
NC-DISC	1	2619.45	2619.45	111.62	.000
Error	108	2534.44	23.47		

As before, it is not possible to interpret the findings for SPANMEM-ACC, SPANMEM-AMT, or NC-DISC. It is interesting that there was no significant difference on ACCDET, the accent detection task. In view of the fact that half of the Spanish words were pronounced with an American accent, it is highly likely that it was possible to perform this task by relying primarily on knowledge of American English pronunciation. Hence, to the extent that monolinguals can accurately perceive the items, they might be expected to do as well as the bilinguals on this task.⁶ It does appear though, that age affects accuracy of perception as is evident from the significant difference in performance shown on this task when older and younger subjects are compared (Table 12).

As explained previously, bilingual subjects also received the listening comprehension subtest (LISTCOMP) of the Spanish version (form MA) of the MLA Cooperative Foreign Language Tests.

⁶This finding is also consistent with previous research which has shown that listeners can be very sensitive to phonetic differences in detecting foreign accents in an acquired language (Flege, 1984, 1988).

In addition, they were asked to read a list of vocabulary items (VOCAB) and indicate which words they knew. Table 13 summarizes subject performance on these measures:

TABLE 13

Spanish Proficiency Measures (Bilinguals)
Descriptive Statistics

	LISTCOMP			VOCAB		
	M	SD	%	M	SD	%
Young	35.93	2.39	89.8	231.75	3.50	98.2
Older	16.62	8.54	41.6	180.70	48.28	76.6

As can be noted, there was a great difference in Spanish proficiency (as measured by LISTCOMP) between younger and older bilingual subjects; the difference in performance on VOCAB was also large. Hence, it is clear that the groups were not comparable in terms of Spanish proficiency.

Since the younger and older bilinguals differed so much in Spanish proficiency, it seems reasonable to assume that some of the differences in their performance on the Spanish perception/production tasks may have been due to differing proficiency levels. Hence, in comparing older and younger bilingual subjects on the full battery of Spanish tasks, a MANCOVA was performed, controlling for proficiency as assessed by LISTCOMP (see Table 14 below).

TABLE 14
Spanish Tasks
Younger vs. Older Bilinguals

Source	df	SS	MS	F	P
SPANMEM-ACC	1	9028.03	9028.03	7.03	.011
Error	50	64181.77	1283.64		
SPANMEM-AMT	1	940.75	940.75	0.63	NS
Error	50	74484.43	1489.69		
ACCDET	1	4.30	4.30	0.16	NS
Error	50	1313.95	26.28		
NC-DISC	1	18.26	18.26	1.39	NS
Error	50	656.89	13.14		
C-DISC	1	116.86	116.86	5.80	.020
Error	50	1006.99	20.14		

The results of this analysis show that the young bilinguals performed significantly better than the older bilinguals on SPANMEM-ACC (the task involving auditory memory as well as perception/production skills) and C-DISC (the contextualized perception task), even when the differences in their language proficiency were controlled. Hence, although the older adults performed similarly to the younger adults on the non-contextualized discrimination task (NC-DISC), when Spanish proficiency was controlled, they did not do as well on the contextualized discrimination task.

The context provided in C-DISC did not appear to enhance performance on this task. Indeed, as reported earlier in Table 10, there was little difference in mean performance on the two discrimination tasks (NC-DISC and C-DISC) for either the younger or older bilinguals. It may be that the semantic context actually made the task more difficult for some of the older bilinguals, as trying to understand the context would require

increased processing, and this added processing burden may have in turn interfered somewhat with their ability to make the perceptual judgment.

At the same time, it is not clear that this result can necessarily be attributed to an age effect. The younger bilinguals uniformly evidenced such a high degree of Spanish proficiency that it may be assumed that they all understood most of the sentences with little difficulty; indeed, their mean score on the VOCAB task, which listed all of the words in the perceptual tasks, was 98.2% correct. However, comprehending the sentences would have been much more difficult for all but a few of the older bilinguals. (Their mean performance on the VOCAB task was 76.6%. It will be recalled that this task required them only to signal knowledge of individual words, which was not necessarily an indication that they would comprehend the words in combination.) Consequently, those older bilinguals who ignored the sentence context, might have performed similarly on NC-DISC and C-DISC. It is the performance of those who did try to extract the meaning of the sentences which may have been impaired. And this impairment might have been uneven across proficiency levels for the older bilinguals (affecting those with a higher degree of proficiency as well), resulting in the significant difference in their performance as compared to the younger bilinguals when Spanish proficiency was controlled. Had there been a greater variation in the proficiency levels of the younger bilinguals, a similar phenomenon might have been evident.

Principal Components Analysis

In order to examine the relationship among the tests administered in this study, and as a data reduction technique in comparing the performance of older and younger subjects, principal components analyses were carried out for both monolinguals and bilinguals on all measures. In each case, three components showed Eigenvalues which were greater than one. Three-component solutions (using varimax rotation) were originally run for both monolinguals and bilinguals; however, the solution for monolinguals was later limited to two components, as the third component in the original solution was not clearly interpretable and did not appear to relate to the issues being examined in this study. The variable loadings on the first two components did not change greatly from the three- to the two-component solution.

Component loadings for monolinguals are displayed in Table 15. (Only those component loadings which exceeded .400 are listed.)

TABLE 15
Monolinguals
Principal Components Analysis

Variables	1	2
SPIN-HC	.880	---
SPIN-LC	.867	---
DIGFOR	---	.720
DIGREV	---	.614
ENGMEM	---	(.394)
SPANMEM-ACC	(.394)	.788
SPANMEM-AMT	---	.639
ACCDDET	.644	---
NC-DISC	.774	---
Eigenvalue	3.453	1.559
Tot. Variance		
Explained	31.99%	23.71%

An examination of the variables which loaded on each component in Table 15 reveals that tests which primarily assessed perception abilities loaded on the first component. SPANMEM-ACC, a measure of perception/production as well as memory capacity, loaded marginally on this component. The second component appears to consist mainly of tests which assessed working memory capacity. SPANMEM-ACC and SPANMEM-AMT also loaded on this component, possibly evidencing the relationship of memory capacity to accuracy and willingness to risk or to attempt a challenging task.

A subsequent MANOVA, using component scores as dependent variables, revealed a significant difference between younger and older monolinguals on the first component ($p < .001$), but no significant difference on the second component. Results of the MANOVA are shown in Table 16.

TABLE 16

Monolinguals: Principal Components
Younger vs. Older Adults

Source	df	SS	MS	F	P
Component 1	1	22.16	22.16	37.39	.000
Error	52	30.82	0.59		
Component 2	1	0.19	0.19	0.18	NS
Error	52	52.81	1.02		

Table 17 displays the results of the principal components analysis for bilinguals:

TABLE 17

Bilinguals
Principal Components Analysis

Variables	1	2	3
SPIN-HC	---	---	.855
SPIN-LC	---	---	.856
DIGFOR	---	.794	---
DIGREV	---	.772	---
ENGMEM	---	.636	---
SPANMEM-ACC	.868	---	---
SPANMEM-AMT	.863	---	---
ACCDDET	.490	---	.630
NC-DISC	.776	---	.476
C-DISC	.705	---	.571
LISTCOMP	.888	---	---
VOCAB	.828	---	---
Eigenvalue	6.787	1.362	1.145
Tot. Variance			
Explained	38.28%	16.19%	22.98%

The relationship among the tests which is revealed for bilinguals is somewhat different than for monolinguals, most likely because of the introduction of an additional variable, that of proficiency in Spanish, as assessed by LISTCOMP (and VOCAB to a certain extent). An examination of component loadings reveals that measures which could be assumed to be sensitive to differences in language proficiency, SPANMEM-ACC, SPANMEM-AMT,

ACCDET, NC-DISC, C-DISC, LISTCOMP, and VOCAB, loaded on the first component.

It is not surprising that the pattern of loading for SPANMEM-AMT is different for monolinguals and bilinguals. Monolinguals were on equal ground in terms of their lack of knowledge of Spanish, and so might have felt similarly about attempting to imitate what to both groups were nonsense words and phrases. Their willingness to utter strings of syllables need have had no relationship to the accuracy of those strings as they had no means to judge the accuracy of their attempts. On the other hand, bilinguals were keenly aware that these were meaningful utterances. Those subjects who were not as proficient as others (primarily older bilinguals) may have been more reluctant to utter nonsense syllables in an attempt to mimic what they may not have understood or may not have been able to retain in short-term memory.

Similar to findings for monolinguals, the English working memory tasks, DIGFOR, DIGREV, and ENGMEM, loaded on a separate component. Perceptual tests which had loaded on the first component, ACCDET, NC-DISC, and C-DISC, also loaded on the third component, joined by measures of SPIN high- and low-context items. Perhaps this component represents a measure of perceptual abilities which is less sensitive to differences in L2 proficiency.

A MANOVA using component scores as dependent variables showed a significant differences between younger and older bilinguals on the first and third components ($p = .001$ and $.005$ respectively), but not on the second component. This is

consistent with the results of the MANOVAs comparing test scores which were reported earlier. Table 18 contains a summary of the results of the MANOVA comparing component scores.

TABLE 18
Bilinguals: Principal Components
Younger vs. Older Adults

Source	df	SS	MS	F	P
Component 1	1	28.06	28.06	62.96	.000
Error	49	21.84	0.45		
Component 2	1	0.21	0.21	0.21	NS
Error	49	49.63	1.01		
Component 3	1	7.41	7.41	8.54	.005
Error	49	42.54	0.87		

The results of the component analysis for bilinguals help tease out the influence of Spanish proficiency on performance on the Spanish perception tasks ACCDET, NC-DISC, and C-DISC. As mentioned above, these tasks loaded on the first component, which appeared to relate to Spanish proficiency, and also on the third component, which appeared to be a more pure measure of auditory perception. The fact that there was a significant difference between the older and younger subjects on the third component as well as the first would appear to indicate that there is a difference in their auditory perception abilities in Spanish beyond what results from their different levels of proficiency.

Conclusions

The purpose of this study was to compare characteristics of younger and older adults which were thought to be crucially involved in the process of speech perception and comprehension in L2 acquisition, specifically working memory capacity and auditory

perception abilities. The findings of the study are summarized below in response to the research questions asked initially:

1. Do older and younger adults differ in auditory perception abilities in their native language (English)?

Results of the Speech Perception in Noise test (SPIN) were evaluated in answering this question. The study did find that older adults had more difficulty in accurately perceiving the sounds of their native language under degraded acoustic conditions. Although both older and younger adults appeared to benefit greatly from the semantic clues present in the high-context items, the performance of the older adults remained inferior to that of younger adults. The low-context items, where word recognition is based almost entirely on auditory perception, were very difficult for both groups, but the gap in performance between older and younger adults doubled in size as compared to their performance on the high-context items. As noted previously, these results are generally consistent with those reported in previous studies.

It was suggested that the difference in performance may have been attributable in part to differences in hearing acuity at higher frequencies, as a large percentage of the older adults, especially males, suffered from presbycusis to some degree.

2. Do older and younger adults differ in short-term auditory memory capacity in their native language?

This study found no difference in auditory memory capacity, as measured by random digit tasks (DIGFOR and DIGREV) and a task involving memory for sentences (ENGMEM), between older and younger adults. As these tasks also involved auditory

processing, it may be concluded that the older and younger subjects shared similar processing abilities, at least for their native language. These findings are similar to those of previous studies in that working memory capacity does not appear to be detrimentally affected by age.

The DIGREV task assessed dynamic memory capacity, requiring additional skill in perceptual reorganization; that older and younger adults performed this task with equal competence would seem to indicate similar capacities in this area as well. In this regard, the older subjects in this study performed better than previous research would have suggested.

An unexpected finding was that both younger and older bilingual subjects performed significantly better than the younger and older monolinguals on all measures of short-term auditory memory span. In fact, comparison with published percentile ranks showed both groups of bilinguals to have performed significantly better than their age norms. It is difficult to identify why this should have been the case. In terms of demographic characteristics, the older adults differed in years of education (the bilinguals had received approximately two years more on average), and both older and younger bilinguals had received some foreign language training (an average of sixteen months for the younger adults and nine months for the older adults), most of it prior to their service in the mission field. As this was a cross-sectional study, the possible effect of acquiring a second language on their auditory memory capacity could not be assessed.

3. Do older and younger adult monolinguals differ in auditory perception abilities in an unknown language (Spanish)?

The results showed that younger monolingual adults perceived Spanish sounds more accurately than older monolingual adults. It is suggested that these differences, similar to those revealed for perceptual abilities in English, may be due at least in part to differences in hearing ability, although the Spanish tasks were administered under quiet conditions.

At the same time, the older monolinguals were able to perform a task requiring rather fine phonetic judgments (ACCDT) with a fair amount of success (close to eighty percent), although still less than their younger counterparts. That these judgments were most likely based on knowledge of English pronunciation does not diminish this achievement. It may be that the acoustic cues involved in judging accentedness fall within the range of frequencies for which the hearing of the older adults is normal. It may also be the case that aging does not have a great effect on the ability to make perceptual judgments in relation to an existing phonetic system if the hearing acuity of the individual and the acoustic conditions are such that the auditory percept is accurately apprehended. However, because subjects could rely on their knowledge of their native language in making these judgments, it was not possible to evaluate the efficacy of judgments based on an evolving interlanguage linguistic system.

4. Do older and younger adults who have some proficiency in a second language (Spanish) differ in auditory perception abilities (taking into account the differences in their level of proficiency)?

The great difference in the average level of Spanish proficiency achieved by the younger and older bilinguals makes it difficult to respond to this question. When language proficiency (LISTCOMP) was controlled, younger and older adults did not differ significantly in their performance on the non-contextualized discrimination task (NC-DISC). The older adults did not perform as well as the younger adults on the contextualized discrimination task (C-DISC); however, it was not clear that this was due to an age effect. The results of the principal components analysis did seem to indicate that the older adults perceived spoken Spanish less accurately than the younger adults, even to a greater extent than would be expected in view of their weaker proficiency.

Implications

It is important to emphasize that the older adults involved in this study are more representative of that segment of the aging population who enjoy relatively good health and engage in activities which may be physically and cognitively demanding. Brown (1983) also studied aspects of the L2 acquisition of younger and older Mormon missionaries. She notes that these learners tend to be highly motivated, as demonstrated by their willingness to pay all of the expenses of their missions and to go wherever they are assigned to serve. Consequently, any implications drawn from the results of this research may apply only to those older individuals of like health and vigor, who have enjoyed comparable levels of formal education and are similarly motivated in tackling the challenging task of acquiring an additional language.

In general it appears that older adults experience a somewhat greater difficulty in perceiving L2 speech. This may be due at least in part, to the effects of presbycusis, which older males experience to a greater extent than do older females. Difficulty in perception for older adults is exacerbated under degraded acoustic conditions, and so it would seem important in a classroom setting that attempts be made to control noise, from that of nearby machinery to whispered conversations among classmates, which would compete with the primary speech signal which is the focus of the class at any given moment, whether it be from the teacher or another student. This increased difficulty in speech perception may account to some extent for the greater reliance on reading, writing, and especially spelling as an aid in comprehension and production, which Brown (1983) found among the older learners she studied.

That the older and younger learners demonstrated similar auditory memory capacity would appear to imply that they are capable of retaining chunks of L2 speech of comparable length, although the differences in their perceptual abilities may influence their success in apprehending and reproducing these chunks. Unfortunately, it was not possible to determine from this study whether their ability to retain meaningful sentences increases in a manner similar to that of young adult L2 learners as they achieve comparable levels of proficiency.

As noted frequently in previous studies, on every measure, without exception, there was a greater variation in scores (as indicated by the standard deviations) among the older adults. This suggests that while many older adults may indeed have an

increased difficulty in acquiring an additional language, others may perform in a manner similar to young adults. Whether or not an individual retains the cognitive abilities of earlier years appears to depend to a great extent upon continued use of these skills in confronting challenging tasks. Indeed, as suggested earlier (Clyne, 1981; Albert & Obler, 1978), the very act of engaging in such a demanding task may help an individual to strengthen or even recover language abilities which may have been weakened.

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